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CYLINDER HEAD ARRANGEMENT FOR A PISTON COMPRESSOR

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Ana R. Rivera
(TYPED OR PRINTED NAME OF PERSON MAILING PAPER OR FEE)

Ana R Rivera
(SIGNATURE OF PERSON MAILING PAPER OR FEE)

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Cross-Reference to Related Applications

[0001] This application is entitled to the benefit of and incorporates by reference essential subject matter disclosed in German Patent Application No. 102 44 565.6 filed on September 25, 2002.

Field of the Invention

[0002] The invention concerns a cylinder head arrangement for a piston compressor, particularly a hermetically enclosed refrigerant compressor, with a suction muffler and a valve package having a valve plate, at least one suction valve and at least one discharge valve.

Background of the Invention

[0003] A cylinder head arrangement of this kind is known from, for example, DE 199 15 918 C2. Here, the refrigerant gas is sucked in through a pipe, which is or can be connected with the suction muffler. A cylinder head cover is fitted on the valve plate by way of a sealing. The valve plate is fitted on the cylinder block of the compressor by way of an additional sealing. Neighbouring parts have an alignment arrangement, so that the best possible overall alignment between the individual parts can be achieved. However, the costs of fitting such a cylinder head are relatively large.

[0004] DE 36 45 083 C2 and DE 199 23 734 C2 show suction mufflers for hermetically enclosed compressors, which are assembled of several housing parts. The housing parts are welded together.

[0005] The invention is based on the task of simplifying the assembly of the cylinder head arrangement.

Summary of the Invention

[0006] With a cylinder head arrangement as mentioned in the introduction, this task is solved in that the suction muffler has a housing, in which the valve package is adopted, the housing having positioning means, which determine the position of the valve package in the housing.

[0007] Thus, the valve package is placed in the suction muffler. This has two advantages. The positioning means position the valve package so that openings in the valve package and openings in the housing of the suction muffler can be brought in conformity with each other with a high accuracy. Additionally, the suction muffler is able to muffle noises, which occur in the valve package. In many cases, this noise muffling exceeds the mere damping of oscillations in the suction gas. For example, the housing can have the shape of a bowl.

[0008] Preferably, the suction muffler is arranged between the valve package and a cylinder head cover. This enables a relatively compact embodiment of the cylinder head arrangement. Further, with this placement, it is possible to use the housing, which is usually made of a plastic material with poor heat conductivity, as a thermal isolator between the cylinder head cover and the valve package. The cylinder head cover comprises a cavity, into which the discharge gas is supplied. After the compression, the discharge gas has an

increased temperature, which is transferred to the inside of the compressor shell via the cylinder head cover, which should, for this purpose, have the best possible heat conductivity. The intermediate position of the housing, however, means that heat is no longer transferred direct from the hot cylinder head cover to the valve package.

[0009] Preferably, the housing has an outer limiting wall and a covering, which has a recess, in which the cylinder head cover is arranged. In the circumferential direction, the cylinder head cover is thus, at least on part of its height, surrounded by the suction muffler. Thus, it is possible to provide the suction muffler with the desired volume, without increasing the dimensions of the cylinder head arrangement excessively.

[0010] Preferably, the recess has a bottom, which is provided with an opening, through which the valve package is connected with a cavity formed on the inside of the cylinder head cover. Thus, it is possible to feed the discharge gas from the valve package into the cavity without significant obstacles.

[0011] Preferably, the cylinder head cover has an outer diameter, which is smaller than the inner diameter of the recess. Thus, it is possible to keep the cylinder head cover in contact with the housing merely via a bearing area. A contact between the housing and the cylinder head cover on the circumference of the cylinder head cover can be avoided. Thus, the heat transfer from the cylinder head cover to the housing is impeded.

[0012] Preferably, an inner limiting wall, which surrounds the valve package, extends from the covering. Thus, the muffling volume of the suction muffler is arranged between the outer limiting wall and the inner limiting wall. In the other direction, the muffling volume is limited by the covering and a cylinder block, on which the housing rests. The inner limiting wall surrounds the valve package and retains it. As the inner limiting wall can be adapted relatively exactly to the outer dimensions of the valve package, a highly exact positioning of the valve package in the suction muffler can be achieved in a simple manner.

[0013] Preferably, the inner limiting wall extends from the bottom of the recess. Thus, it is possible to position the valve package on the side of the opening opposite to the cylinder head cover. The cylinder head cover then forms the continuation of the stack, which is formed by the valve package.

[0014] Preferably, in the direction of a compressor block, the inner limiting wall projects less than the outer limiting wall, the covering being so flexible that also the inner limiting wall can be brought to rest on the compressor block by means of a clamping arrangement. With this simple measure, it is possible to bring the muffling volume to rest with both the inner limiting wall and the outer limiting wall on the compressor block with a sufficient tightness, without redundant geometric determination of the resting points. The resting of the inner limiting wall on the

compressor does not occur until the housing of the suction muffler is fixed. This gives a good sealing of the muffler.

[0015] Preferably, the outer limiting wall is provided with a sealing, which is meant to rest on the compressor block. This sealing can be moulded direct on the end face of the outer limiting wall in the form of a lip seal. It can also have the form of a loose component. It is also possible to use a planar sealing, which is arranged between the compressor block and the housing of the suction muffler and covers the surface of the compressor block at least in the area of the muffling chamber. In the latter case, the heat transfer from the relatively hot basis, namely the compressor block, to the suction gas in the muffling chamber is reduced.

[0016] Preferably, the valve package and the inner limiting wall have a mutually adapted groove-projection geometry, which serves as positioning aid. Thus, the purpose of the inner limiting wall is no longer restricted to keeping the valve package in the right position inside the housing of the suction muffler. The groove-projection geometry also permits a positioning of the valve package in a predetermined angular position in relation to the housing. For example, projections can be formed on the limiting wall, which project into grooves on the valve package. On the other hand, it is also possible to provide the valve package with projections and to provide corresponding grooves in the inner limiting wall.

[0017] Preferably, the groove-projection geometry is made to be asymmetrical. Thus, it can be ensured that the valve package can only be inserted with a predetermined angular alignment in relation to the housing. Firstly, this simplifies the mounting. Secondly, the angular position of the valve package in relation to the housing can be determined so that the most optimal path for the suction gas or the discharge gas, respectively, appears.

[0018] Preferably, the compressor has a cylinder with a front side fixing surface, which has the same outer contour as the valve package and is adopted in the housing. Thus, not only the valve package is adopted in the housing, or rather, in the inner limiting wall, but the inner limiting wall is extended so much that it also surrounds the cylinder in the area of the fixing face. This gives several advantages. Firstly, the position of the valve package in relation to the cylinder is even more accurately fixed. The cylinder and the valve package are retained by the same positioning aid. Secondly, also the suction muffler is better fixed on the compressor block, primarily with regard to lateral loads.

[0019] Preferably, the fixing surface is made on a circumferential flange. This saves material, that is, the overall wall thickness of the cylinder can be kept smaller.

[0020] Preferably, the inner limiting wall has an extension, which corresponds to the total height of the valve package plus the thickness of the flange. Thus, it is possible to make the inner limiting wall rest on the compressor block.

[0021] This particularly applies, when the flange rests on the compressor block with the side facing away from the valve package. In this case, the cylinder is positioned in a simple manner in the axial direction in relation to the compressor block.

[0022] Preferably, the inner limiting wall has at least one opening, and the valve package has at least one suction gas channel extending in the radial direction. Thus, the suction gas enters through the opening into the chamber, which is surrounded by the inner limiting wall. Here, the valve package is arranged, which is also enclosed relatively tightly by the inner limiting wall. As, however, the valve package has one or more radially extending suction gas channels, the gas sucked in has no problems in reaching the suction gas channel and the compression chamber of the compressor via the opening in the inner limiting wall, which overlaps the radial suction gas channel. Additionally, the radially extending suction gas channel has the advantage that it is easier to separate the suction gas from the discharge gas. This again causes that a heat transfer from the discharge gas to the suction gas is reduced, which improves the efficiency of the compressor. Further, it is no longer necessary to lead the suction gas channel(s) and the discharge gas channel(s) through both a valve plate and a retainer element, which serves the purpose of limiting the opening movement of the discharge gas valve. Thus, a larger cross-sectional area is available for a discharge gas opening, which again has a favourable effect on the flow behaviour of the discharge gas.

[0023] Preferably, at least one baffle is arranged in the area of the opening. The baffle or baffles, which can, for example, extend from the covering, serve the purpose of deflecting the suction gas flow in the direction of the opening, preferably so that the suction gas meets the valve package substantially from the radial direction.

[0024] Preferably, a front side of the housing has a concavity, which only extends over a part of the width of the housing. At this step or concavity, a recess exists in the housing, which can serve the purpose of adopting a suction connection. On the one hand, this gives room for the suction connection; on the other hand, the volume of the muffling chamber of the suction muffler remains large, without requiring an enlargement of the outer dimensions of the compressor housing.

[0025] It is preferred that the concavity has the shape of a lying half cylinder; the front side of said half cylinder having a muffler inlet opening. The half cylinder is relatively easily adaptable to the cylinder shape of a suction connection. The volume of the muffling chamber is not substantially reduced.

[0026] Preferably, a baffle arrangement is arranged opposite to the muffler inlet opening inside the housing. The baffles of this baffle arrangement guide the suction gas sucked in by the suction connection in the direction of the openings in the inner limiting wall and reduce the flow resistance of the suction muffler. At the same time, the baffle arrangement has a certain oil separation effect. A share of

the oil particles carried along by the suction gas flow cannot follow the deflection and will therefore deposit on the surface of the baffle arrangement. Separated oil can leave the muffling chamber through an oil outlet opening in the outer sidewall and get to an oil sump, which is formed inside the compressor housing.

[0027] Preferably, the muffler inlet opening on the outside of the housing is surrounded by an annular wall. Also with small movements, this permits keeping the suction connection in close contact with the outside of the suction muffler. This is particularly favourable, when the corresponding bearing surface of the suction connection substantially corresponds to the surface of a ball section and forms a ball joint with the suction muffler.

Brief Description of the Drawings

[0028] In the following, the invention is described in detail on the basis of a preferred embodiment in connection with the drawings, showing:

[0029] Fig. 1 a vertical section through a refrigerant compressor

[0030] Fig. 2 an exploded bottom view of the elements of the cylinder head arrangement

[0031] Fig. 3 top view a suction muffler with mounted cylinder head cover and inserted retainer element

[0032] Fig. 4 a section B-B according to Fig. 3

[0033] Fig. 5 a bottom view of the suction muffler according to Fig. 4.

Detailed Description of the Preferred Embodiments

[0034] Fig. 1 shows a longitudinal section through a refrigerant compressor 1, which is arranged in a compressor housing 2. The refrigerant compressor 1 has a compressor block 3, which carries a cylinder 4. In the cylinder 4 is a piston 5 arranged to be movable, said piston 5 being driven by a motor 6 via a connecting rod 7. Together with the cylinder 4, the piston 5 delimits a compression chamber 8, in which sucked in refrigerant gas is compressed, when the piston 5 moves to the left (in relation to the view in Fig. 1).

[0035] For controlling a gas flow into the compression chamber 8 is provided a valve plate 9, which has (Fig. 2) two suction openings 10 (only one shown) and a discharge opening 11. On the side of the valve plate 9 facing the cylinder 4 is arranged a suction valve plate 12, which has a valve leaf 13 for each suction opening 10. The valve leaf 13 is formed in the suction valve plate 12 by means of punching. Usually it is arranged in the level of the suction valve plate 12, that is, it bears on the valve plate 9. Only when gas is sucked in through the suction opening 10, the valve leaf 13 is lifted from the valve plate 9, permitting the gas to pass. When the piston 4 performs a pressure stroke, the valve leaf 13 is brought to bear on the valve plate 9 again.

[0036] In a similar manner, a discharge valve plate 14 is arranged on the side of the valve plate 9 facing away from the suction valve plate 12, said discharge valve plate 14 having a valve leaf of a discharge valve (not shown in detail). In order to limit the movement of the valve leaf of the discharge valve plate 14, a retainer element 15 is provided.

[0037] Together, the suction valve plate 12, the valve plate 9, the discharge valve plate 14 and the retainer element 15 form a valve package 16. All parts of the valve package 16 have the same outer dimensions. Preferably, they are circular and have the same diameter.

[0038] Together with a suction muffler 18 and a cylinder head cover 19, the valve package 16 forms a cylinder head 17. The cylinder head cover 19 is made of a material with high heat conductivity, particularly a metal. It delimits a discharge chamber 20, which receives gas through the discharge opening 11, when the piston 5 reduces the compression chamber 8, that is, exposes the gas to pressure. The cylinder head cover 19 has an outlet opening 21, through which the compressed gas can be discharged.

[0039] The suction muffler 18 has a housing 22, which has an outer limiting wall 23 and a covering 24. The covering 24 has a recess 25, in which the cylinder head cover 29 is arranged. The inner diameter of the recess 25 is somewhat larger than the outer diameter of the cylinder head cover 19, or rather, than the outer diameter of a flange 26, which projects radially from the cylinder head cover 19. Thus, it

is avoided that the cylinder head cover 19 with its flange 26 touches the housing 22 laterally. On the contrary, the contact between the cylinder head cover 19 and the housing 22 is limited to the bearing surface of the cylinder head cover 19 on the housing 22.

[0040] On the side opposite the cylinder head cover 19, an inner circumferential wall 27 extends from the bottom of the recess 25.

[0041] In the recess 25 is provided an opening 28, through which the cylinder head cover 19, or rather, the discharge chamber 20 formed in the cylinder head cover 19, is connected with the valve package 16.

[0042] In its flange 26, the cylinder head cover 19 has several openings 29 distributed in the circumferential direction. Corresponding openings 30 are also formed in the parts of the valve package 16. The cylinder 4 has a circumferential flange 31, which also has openings 32. The openings 29, 30, 32 can be brought in alignment with each other. Fixing bolts can be inserted through these openings. Corresponding through holes 34 are provided in the bottom 33 of the recess 25, through which corresponding fixing bolts can be inserted. The openings 29, 30, 32 and the holes 34 are so large that the corresponding fixing bolts do not have to touch the parts of the valve package 16, the flange 31 or the housing 22. Other components are provided for the alignment of the parts.

[0043] This can, for example, be seen from Fig. 5. On the inner limiting wall, projections 35, 36 project radially inward. The projections 35, 36 are arranged to be asymmetrical, that is, the projection 36 has a larger radial extension than the projection 35. In the parts of the valve package 16 and in the cylinder flange 31 corresponding grooves 37 are provided, which engage with the projections 35, 36, when the valve package 16 and the cylinder flange 31 are inserted in the housing 22. Thus, initially, the parts 12, 9, 14, 15 of the valve package 16 are retained by the inner limiting wall 27. These parts all have a circular shape. The inner limiting wall 27 encloses a corresponding, circular chamber. Thus, the valve package 16 is guided on all sides. The cooperation of the projections 35, 36 with the grooves 37 causes an angle alignment of the valve package 16 or its parts 12, 9, 14, 15, respectively, in relation to each other and in relation to the housing 22 of the suction muffler 18.

[0044] Corresponding grooves 38 are also provided on the flange 26 of the cylinder head cover 19, so that also the cylinder head cover 19 can be mounted with a predetermined alignment in relation to the valve package 16 and the housing 22 of the suction muffler 18. This gives advantages with regard to assembly techniques.

[0045] Thus, the suction muffler 18 is arranged between the cylinder head cover 19 and the valve package 16. The valve package 16 can thus either be inserted in the chamber inside the inner limiting wall 27 in the assembled state or the individual parts can be inserted one after the other.

[0046] On the side facing the valve plate 9, the flange 31 of the cylinder 4 forms a bearing surface for the valve package 16. The inner limiting wall 27 extends so far in the direction of the compressor block 3 that also the thickness of the flange 31 is still within the inner limiting wall 27.

[0047] As can be seen from Fig. 4, the outer limiting wall 23 extends somewhat farther than the inner limiting wall 27 (in Fig. 4 both walls extend to the left). On the outer limiting wall 23 is arranged a circumferential sealing 39. This sealing 39 is brought to rest on the compressor block 3. When the housing of the suction muffler 18 is merely placed on the compressor block 3, the inner limiting wall 27 still has a small distance to the surface of the compressor block. The covering of the housing 22 of the suction muffler 18 is to some extent flexible, so that by means of a fixing bolt 40, with which the suction muffler 18 is fixed on the compressor block 3, it can be ensured that also the inner limiting wall 27 bears on the compressor block 3. A muffling chamber 41, which is formed between the inner limiting wall 27 and the outer limiting wall 23, is thus sealed on its complete boundary.

[0048] As can be seen from Fig. 1, the flange 31 in the mounted state also bears on the compressor block 3. The cylinder 4 is led through the compressor block 3 from the side facing away from the motor 6. Also this simplifies the assembly. By means of the circumferential flange 31 of the cylinder 4, the suction muffler 18 is additionally secured on the compressor block 3 against displacement movements.

[0049] As is particularly obvious from the Figs. 2 and 5, the inner limiting wall 27 has two gaps 42 or openings, which, in a manner of speaking, form the outlet from the muffling chamber 41. In front of the gaps 42, baffles 43 are arranged, which direct a refrigerant flow into the gaps 42 in the inner limiting wall 27. These baffles 43 improve the flow properties.

[0050] As shown schematically in Fig. 5, the valve package 16 has substantially radially extending suction channels 44, which are formed by recesses 45 in the retainer element 15 and the valve plate 9 (not visible in Fig. 2) as well as a cut-away 46 in the discharge valve plate 14. Thus, the suction channel 44 extends between the retainer element 15 and the valve plate 9. The retainer element 15 separates the suction channel 44 from the discharge chamber 20, so that a heat transfer from the compressed discharge gas to the suction gas sucked in is impeded. Additionally, it is possible to make the retainer element 15 of a material with poor heat conductivity, for example a ceramic material. In this case, the heat transfer from the hot discharge gas to the colder suction gas is further impeded.

[0051] At one end, the housing 22 of the suction muffler 18 has a concavity, in which a connection element 48 to a suction connection 49 can be arranged (Fig. 1). In the cross-section, said concavity 47 has the shape of a half cylinder, so that here the cylinder-shaped connection element 48 is arranged at a certain distance. The concavity 47 does not extend over the whole width of the housing 22.

Thus, the volume of the muffling chamber remains relatively large. The connection element 48 has a substantially ball-shaped front side 50, which bears on an annular wall 51, which surrounds a muffler inlet opening 52. The annular wall 51 can be surrounded by an additional annular wall 53, which projects further from the housing and serves as an additional protection against oil, which runs off from the housing.

[0052] As can be seen from the Figs. 2 and 5, a baffle arrangement 54 with two baffles 55 is arranged opposite the muffler inlet opening 52, which baffle arrangement 54 guides a gas flow, which enters the muffling chamber 41 through the muffler inlet opening 52, in the direction of the baffles 43 in front of the gaps 42 of the inner limiting wall 27. Additionally, the baffles 55 serve the purpose of an oil separation. A share of the oil particles carried along by the suction gas flow cannot follow the deflection. They settle on the surface of the baffles 55. Oil separated in this manner can flow off from the muffling chamber 41 through an opening 56 in the outer limiting wall 23, into an oil sump, which is not shown in detail, which is arranged inside the compressor housing 2.

[0053] The bottom 33 of the recess 25 of the housing 22 is relatively thin. During assembly, this area is fixed between the cylinder head cover 19 and the retainer element 15 of the valve package 16. As it is relatively flexible, it practically acts as a sealing between the discharge chamber 20 in the cylinder head cover 19 and the muffling chamber 41 of the suction muffler 18.

[0054] Instead of the lip seal 39 shown in Fig. 4, which is moulded onto the outer limiting wall 23, of course a sealing can also be used, which is formed as a separate component. Also a planar sealing (not shown) can be used, which is arranged between the compressor block 3 and the suction muffler 18 or the flange 31, respectively, and covers the compressor block 3 at least in the area of the muffling chamber 41. With such a sealing, the heat transfer from the relatively hot basis of the compressor block 3 to the suction gas in the muffling chamber 41 is reduced.

[0055] The fact that the valve block 16 is arranged inside the suction muffler 18 causes that the muffling chamber 41, which is limited by the outer limiting wall 23, the inner limiting wall 27, the covering 24 and the compressor block 3, does not only muffle noises which occur in the suction gas flow, the suction muffler 18 can also reduce mechanical noises from the valve package 16.

[0056] In order to avoid flow noises and flow losses, the limits of all openings and channels are rounded, that is, for example the edges of the suction opening 10 and the discharge opening 11 as well as the edges of the gaps 42.

[0057] In a manner not shown in detail, the flange 26 of the cylinder head cover 19 can additionally be provided with a circumferential projection projecting in the axial direction. This projection increases the rigidity of the complete cover. Further, it offers a larger heat emission

surface, so that the gas in the discharge chamber 20 can be cooled faster.